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Summary

A renewal of science education in Europe

Views and Actions of National Academies

ALLEA Working Group Science Education

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connecting excellence

Abstract:
In order to maintain the passion for science and technology among the young and prepare a scientific and technical workforce sufficient for today's knowledge-based societies, 25 European National Academies, all engaged in promoting the renewal of science education, plead for the extension of inquiry-based science education at primary and lower secondary school, and for a strong effort in the sphere of science teacher training (pre- and in-service). To raise the awareness of stakeholders in politics, they strongly recommend better interaction at the level of the national education systems, and among the educational and scientific communities and the corporate sector.

Note:

This document summarises a report of the Working Group (WG) on science education of ALLEA, a report edited in May 2012 by the WG chairperson Odile Macchi and Rüdiger Klein (at that time executive director of ALLEA), with the active participation of the WG members. ALLEA (ALL European Academies) is the federation of 52 academies of sciences and humanities from more than 40 countries in the Council of Europe region. Its WG on science education, currently with delegates from some 25 academies, functions also as the regional European council of the science education programme of IAP (InterAcademy Panel), the global network of science academies. The report analyses surveys conducted in 2010 and 2011 and draws up recommendations. It can be found on the ALLEA website (www.allea.org).

The report itself details the views and actions taken by European National Academies to advance the renewal of science education and maintain the passion for science and technology among the young, typically drawing on the support of leading scientists from the science academies. It was written in response to a request of the European Commission seeking to establish the national impacts across Europe of the Framework Programme pilot projects in the pursuit of better science education. In addition to a general introductory analysis and concluding recommendations, the report involves detailed contributions from 25 European countries, including qualitative narratives on the following themes, among others: the promotion of inquiry-based science education (IBSE) in schools, networking and peer learning through EU co-funded projects, the means available under the subsidiarity principle for the most appropriate local implementation of this renewal, interaction between the national and local education authorities, institutional solutions and the role of leading scientists in science teacher training, informal science events, among other things. In order to renew science education throughout Europe, the report mainly pleads for IBSE extension and for a strong effort in the sphere of science teacher training (pre- and in-service), through better interaction at the level of the national education systems and between the scientific community and stakeholders in politics, society and the corporate sector.

Summary

A renewal of science education in Europe

Views and Actions of National Academies

THE BACKGROUND: A REACTION BY SCIENCE ACADEMIES TO THE DECLINE OF INTEREST IN SCIENCE AND THE SHRINKING SCIENTIFIC WORK FORCE

The decline of interest in science has become a concern for all academies of sciences. Paradoxically, in Europe's technologically advanced societies, scientists, engineers and technicians struggle with the problem of a skewed image and decreasing public recognition, and careers in S&T appear to students as an uncertain choice. A shortage of scientific and technological staff in the labour market seems possible soon, and this current trend risks endangering these countries' future as full members of a knowledge-based European society. One reason among several is that in primary schools science is often taught in an unexciting mode, in a mainly deductive pedagogy with a low level of interaction, and so students find it boring. Moreover, science is sometimes not taught at all. This situation makes the task of transforming science education at early ages in Europe necessary but daunting, as a million primary school teachers and some 100,000 secondary school teachers require additional in-service training.

Yet the process of renewing science teaching is making progress. It now takes place in the context of a better awareness of the need to equip a nation with a minimum of scientific knowledge. For instance, at the end of the last century, in 1999, the World Conference of Science held in Budapest and sponsored by, among others, UNESCO, recognised *"an urgent need to renew, expand and* diversify basic science education for all ". The conference declaration viewed the following as commitments and requirements for science and cultural organisations the world over: *"Science education, in the broad sense, without* discrimination and encompassing all levels and modalities, is a fundamental prerequisite for democracy and for ensuring sustainable development. In recent years, worldwide measures have been undertaken to promote basic education *for all … Special attention still needs to be given to marginalized groups. It is* more than ever necessary to develop and expand science literacy in all cultures and all sectors of society as well as reasoning ability and skills and an appreciation of ethical values, so as to improve public participation in decision-*making related to the application of new knowledge."*

Academies, in particular European ones, in the early 21st century have gathered their intellectual and reputational resources to make governments understand the urgency of a thorough reform in the ways we teach our children the tools that will empower them to steer their world responsibly. National academies have a strong and long-standing commitment to promoting science literacy and formal and informal science education in their countries, often with the help of European Union co-funded programmes, and in alliance with educational authorities and influential partners in the corporate sector. Their shared objective of rejuvenating science education has made it easy to bring together the European academies in this ALLEA Working Group (which is also the regional European council of the global IAP science education programme); the WG has a strong focus on inquiry-based science education (IBSE, see below). Their collective authority, very often supported by teaching professionals, industrialists, parents' organisations, among others, is currently playing a central role in creating a consensus at the various national or regional levels and in the adoption of measures to reform teaching. For instance, on 4th December 2003 a statement on "Science Education of Children" was issued at an InterAcademy (IAP) plenary meeting in Mexico City and was signed by 29 European science academies (see the statement in the Recommendations section). In May 2011 a joint statement of recommendations from the science academies of the G8+ countries was submitted to the Heads of State meeting in France, entitled *"Education for a Science-Based Global Development".* This statement (also included in the Recommendations section) is set in the context of building knowledge-based, scientifically literate societies the world over.

INQUIRY-BASED SCIENCE EDUCATION

In 2007, the so-called Rocard report "Science Education NOW: A renewed Pedagogy for the Future of Europe", produced by the European Commission, argued as follows: *"A reversal of school science*-teaching pedagogy from mainly deductive to inquiry-based methods provides the means to increase interest in science. IBSE has proved its efficacy at both primary and secondary levels in *increasing children's and students' interest and attainments levels while at the* same time stimulating teacher motivation. IBSE is effective with all kinds of students from the weakest to the most able and is fully compatible with the *ambition of excellence. Moreover IBSE is beneficial to promoting girls' interest* and participation in science activities. Finally, IBSE and traditional deductive approaches are not mutually exclusive and they should be combined in any science classroom to accommodate different mind-sets and age-group *preferences."* Indeed, inquiry-based approaches appeal to the natural curiosity of children and strengthen their creativity and critical questioning at the age when they are eager to discover the world around them and to understand how

it functions (i.e. at pre-school, primary and lower secondary school level). Later, as citizens, these people will adopt scientific and social innovations more easily. These approaches typically transcend traditional disciplinary divisions, because the units are problem-centred. They are also beneficial for the students' cognitive and linguistic development, and encourage a constructive type of cooperative work in small groups. IBSE activities have more immediate links with issues of daily life, which contributes to raising the performance of girls in the science classroom to the same level of achievement as boys. With an increased passion for inquiry and research in the classroom, the atmosphere improves, which is rewarding for the teacher too. All these benefits have in fact been observed in the Europe-wide pilot projects that have implemented IBSE; the practice of this and similar types of novel pedagogy is thus gradually being extended. We note that the excellent experiences of a few European countries (mainly France, Sweden and the United Kingdom) remain critical in mobilising the interest of other countries to move beyond pilot projects, making specific adaptations to the challenges of their respective school systems.

We also note that the innovative French IBSE programme "La Main à la Pâte" (hand in the dough), launched and supported by the Académie des sciences now extends to 35% of French primary schools and has prompted imitators around the world, and especially in Europe. In the full report can be found a detailed account of it, in which the key ideas and successes of IBSE are detailed thoroughly. The Royal Swedish Academy of Sciences adopted the IBSE "Naturvetenskap och teknik för alla" programme (science and engineering/technology for all) developed in the U.S.A. early on and adapted it to the Swedish school system.

COMMON FEATURES OBSERVED IN THE ACADEMIES' REPLIES TO THE SURVEY

Convergence of intentions:

The survey demonstrated that the national academies that participate in the ALLEA WG on science education are engaging with the process of science education reform at pre-school, primary and secondary school level on the basis of a far-reaching convergence of reasons, intentions and reflections: the pervasive lack of interest, among pupils, in S&T; followed by a serious decrease of the number of students in sciences, mathematics and engineering; the hazard of society's declining scientific literacy; and of a lack of the necessary scientific skills among the available workforce. Typically the academies' actions are based on in-depth reports intended for their respective governments and other stakeholders. Many academies have decided to deal with the roots of this problem and to begin their interventions at the earliest stages of formal

education, in primary school and even in kindergarten, and in informal environments suitable for children's first encounters with science education.

No correlation with PISA (vel sim.) benchmarking:

There is no immediate correlation between the performance of a given national education system in the relevant international benchmarking exercises such as PISA or TIMMS and the intensity of intervention or the method chosen by a national academy to engage with the process of reforming science and technology education in its country.

Agreement on IBSE approaches:

Reflecting the recommendations of the Rocard report, there is a broad agreement among academies that inquiry-based approaches hold the key to renewing science education. Indeed there is by now sufficient evidence from the numerous projects that young children, once equipped with the tools to understand the nature of science, develop a real interest and, perhaps, even a desire or taste for a career in science.

Teacher Training and the necessary systemic reforms:

Despite the positive aspects of IBSE, the pilot experiences in science teaching do not translate easily in any country into a systemic change in schools, and, whatever the country, the path to this remains long. Revisiting teachers' training is indispensable for implementing a sustainable change. While initial training would seem feasible in principle in most countries, the necessary in-service training and appropriate specific continuous professional development (CPD) are huge challenges, not only because it is necessary to revisit pedagogical ideas (including IBSE approaches), but also because of the financial means required to train high numbers of primary school teachers already in service. Everywhere, interventions at very high levels, both in the political sphere and in the business world, are necessary in order to motivate action by ministerial and political decision-makers.

The beneficial role of European programmes:

While European initiatives in education cannot interfere directly in Member States' policies (due to the principle of subsidiarity), the cross-border exchange of ideas and novel practices that has been facilitated by EU projects can be shown to have triggered continent-wide reflections and debates. For many academies, the participation of their country in European co-funded projects (often inspired by French experiences and led by French partners) such as SciencEduc, or Pollen and Fibonacci, to name but a few, is regarded as a

decisive seed factor. These projects have been eminently useful as a means of broadcasting innovation in the sector. The networking of international experiences facilitated an accelerated learning process and led to spectacular progress in some countries. It gave a strong impulse to the renewal of science education, and all academies acknowledge that the corresponding peer-to-peer interaction and cross-border exchanges were strongly beneficial. Even in France, the lead country, they reinforced the position of the programme, adding to its reputation and helping to secure continued ministerial support and close and formal contacts with relevant authorities. These international networks and projects helped to convince and prepare national actors to take further local initiatives, e.g. on curricula, institutional structures or legislative rules. They stimulated experiments with imaginative and creative proposals for change relative to ideas at national, regional or local level, and helped start the implementation of sustainable renewal in science education.

SPECIFICITIES

The diversity of approaches towards renewing science education reflects the variety of educational systems in European nations, which in turn reflects social, regional or political parameters; education authorities, too, are structured differently. In certain countries policy efforts focus on low achievers and the political concern with the issue is primarily inclusiveness (minorities, gender etc.), while elsewhere there is an emphasis on identifying and nurturing talented students, either as part of a specific academy policy, or as a reflection of the priorities of the national education system. The duration and intensity of participation in EU co-funded science education projects varies, as does the degree to which academies have been involved in them and are able to inject results from these projects into existing systems. The actors, means and processes that are leading the development of IBSE (academies, national associations, foundations, seminars, workshops, etc.) are also very diverse. As a consequence of this vast diversity, the envisaged impact and form of the activities launched by academies at national or local level vary considerably.

RECOMMENDATIONS

We start this section with the two highly authoritative recommendations already mentioned at the beginning of this summary, then we provide detailed recommendations based on the academies' replies to the survey of the ALLEA working group on science education.

The 2003 IAP recommendation or Mexico statement: "Science Education of Children"

« Must all children learn science at school? » The answer is "Yes." Science opens young people's minds to the wonders of the natural world; introduces them to the elegance and honesty of scientific endeavours; and equips them with cognitive and problem-solving tools that will serve them w*ell in the future …* As children become familiar with the universality of the laws of science, they also learn to recognize science's ability to create and cement together a unity for humanity. As citizens, science helps children develop the mental and moral predispositions to imagination, humility, rigour, curiosity, freedom and tolerance - all essential ingredients for peace and democracy. Therefore, the InterAcademy Panel on International Issues (IAP) recommends to all national leaders that:
1/ science teaching to both girls and boys begin in their primary and nursery *schools …;*
2/ this teaching should be closely tied to the realities …;
3/ this teaching should be based, to a large extent, upon models of inquiry-based pedagogy
4/ one should avoid, as far as possible, a teaching which is handed down *vertically …*
5/ links should be established between teachers, via the Internet …
6/ priority should be given to the networking of schools …

The May 2011 recommendations from the G8 Academies:

The joint statement from the science academies of the G8+5[1] countries submitted to the Heads of State meeting in France and entitled *"Education for a* Science-*Based Global Development"* strongly recommends the following action plan to their Governments:
1/ Establish the conditions for a true globalization of knowledge in science and technology. Encourage and help governments of developing countries, to give high priority to acquiring and maintaining the necessary infrastructure and human resources for science education, and to facilitate the return of those trained abroad.
2/ Support international collaboration to set up quality e-learning facilities, accessible to all, including students worldwide, and promote open access to scientific literature and databases.
3/ Share the growing knowledge derived from brain research, cognitive sciences and human behavioural research to improve learning programs for children, students and the general public.

[1] The G8 academies invited five other academies from emerging and developing countries to join in the preparation of the statement, with the purpose of making it more pertinent worldwide. Hence the term G8+5.

4/ Create a network of virtual collaborative research centres at the front line of innovations in education, such as e-learning, inquiry-based and evidence-based education.
5/ Support and expand existing successful programs which facilitate the two-way interactions between scientists, on the one hand and the general public, media, *and decision makers, on the other."*

DETAILED RECOMMENDATIONS

The detailed recommendations presented below should be seen in the worldwide framework of the global recommendations quoted above. In particular they develop recommendations 4/ and 5/ of the G8+5 statement in a way adapted to the specific European situation.

Adapting IBSE methodologies to secondary schools:

While, during their first years, science renewal programmes focused on introducing IBSE to primary schools, a European/Latin-American workshop held in Santiago de Chile in January 2010 revealed that, with a view to sustaining interest for S&T among the school population, possibilities should be explored for adapting IBSE methodologies to secondary schools. This conclusion is all the more valid for Europe, as IBSE projects have already been tried out experimentally in secondary schools in different countries and a global conference on "Taking IBSE into Secondary Schools" convened at the UK's National Science Learning Centre in York in October 2010 by IAP and ALLEA (with support from Royal Society and Wellcome Trust) has recommended progress in this direction.

The necessity of evaluating the impact of teacher professional development focused on IBSE on teacher's practices and pupils' learning:

Although small-scale and qualitative insights indicate improvements in the readiness for change of some actors in national education systems, the information collected so far on pilot projects does not provide sufficient quantitative and general evidence about the direct positive impact of IBSE on teacher's practices and pupils' learning. As comparative benchmarks are becoming ever more important in steering policies, it is a matter of urgency to develop appropriate methodologies that provide some numerical measures of the benefit brought by IBSE or similar approaches, in particular for pupils' learning. This is all the more urgent as the age cohorts that went through the past IBSE projects approach the moment of making career choices. More hard evidence on the long-term beneficial effects of such novel approaches to science teaching on national education systems are needed to prompt a change

of mind among national policy-makers. Further comparative and longitudinal projects on a European scale should help to complete the current set of data (and methods), so that meaningful comparisons of pupils' learning and achievements under different teaching approaches can be made. Thus it is necessary to design appropriate evaluation methodologies to measure the relative success, or otherwise, of ambitious IBSE approaches on the pupils' school competencies and knowledge. It would be equally important to better understand the impact of IBSE methods on teachers' attitudes towards learning and teaching methods before and after taking part in professional development courses focused on IBSE. Some studies, mostly based on teachers' feedbacks through questionnaires, have been undertaken and show a significant impact of continuing professional development on teachers' confidence and improved science teaching skills. Yet, the difficulty of measuring with precision the impact of teachers' input on pupils' output calls for more rigorous experimental studies and randomised controlled trials, some of which are currently being carried out or at the planning stage by several teams and CPD organisations in several countries.

Acting cooperatively with educators and transversally:

Needless to say, academies should not act in isolation, but should increase their degree of interaction with other pioneering forces in the communities of science teachers and teacher training professionals and also in parents' associations, which may have an interest in reforming science education. Within academies, a scientific committee in charge of science education and its reform is an important body for mobilising the scientific community. It should transcend disciplinary and specialist approaches and look at the nature of science and its phenomena in an interdisciplinary way. Academies – as typically multidisciplinary institutions – are well placed to privilege such an approach.

Being active in societal debates:

Since much of science is financed from public funds, citizens as taxpayers deserve to be adequately informed about prospects of reform. Through studies, reports, colloquia and media appearances, academies, as leading representatives of the national science systems, should stimulate national debates about the need to rejuvenate science education, about the opportunities offered by IBSE and about the related measures to be taken for the training of teachers of science. Because their voice is listened to, academies have to make efforts to expand the reach of their communication, conveying the urgency of renewing science education to fellow scientists, teachers, parents' associations, local and international businesses, and policy makers. They can help enhance awareness of the need to reform science education by establishing national,

regional or local platforms where the merits of IBSE approaches and the successes of pilot projects can be demonstrated. Opportunities abound for pointing up the need for science literacy, e.g. whenever public debates touch upon controversial science-induced societal choices, whether that be genetically modified organisms or energy choices, biomedical technologies or biodiversity, global warming etc.

Academies should also build alliances with industrial, corporate and political bodies:

Industries and corporations have a strong interest in the reform of science education, since it should provide them with a larger and better-qualified workforce. Consequently, exchanges between them and academies are among the important socio-economic drivers of the reform efforts.
In the political domain: Academies, representing the best of science in a given country, have the rare ability to access political decision-makers. Making full use of this opportunity to inform and influence political environments with regard to issues of science education and IBSE is an evident strategic choice for academies. At the national/regional level, the academy is recognised as a natural partner by funding agencies and foundations, and also by actors who have to reflect and decide about curricula in science. They can build arguments for institutionally anchoring IBSE approaches in school curricula, or, where the curricula have already been updated, they can help ensure that realistic conditions are created to make teaching under such innovative methodologies possible.

The training and continuous professional development of science teachers:

The training of science teachers is recognised as a key point for the sustainability of all efforts in renewing science education in the coming years. It includes as a main task in-service training of primary school teachers: a large section of the teachers currently employed at primary schools were never taught science as part of their initial pre-service training. Consequently they must improve their disciplinary knowledge, which, at the same time, will make it possible for them to switch to new, inquiry-based pedagogical approaches. For these teachers there is a double challenge of (i) accepting and being introduced to IBSE approaches and (ii) seeing in-service training and continuous professional development as a necessity. Far from seeing it as another professional constraint imposed on them, they should be helped to view CPD as enjoyable and beneficial for their personal development.
This is a key area of intervention for academies. They can contribute from several angles: they can help to create high-quality didactic resources; ensure

that the latter strike a balance between "real life" science topics and up-to-date scientific knowledge; provide access to equipment for related hands-on experiences, where appropriate; influence decision makers to grant funds to good training programmes and to introduce career-relevant incentives; be high-level multipliers of the message that it is necessary to renew teachers' CPD (due to their access to the ministries and the media).

Through their European Working Group ALLEA member academies should play their part in these efforts, making sure also that lessons learnt elsewhere about teaching procedures and practices do not go unnoticed. The comments and recommendations contained in this report also apply to this aspect: an overarching European framework for CPD would be welcome. Considering the approximate number of one million primary school teachers already in service in Europe and the slow-moving labour market in the sector, a significant improvement in science education largely depends on the development of an efficient and advanced methodology for sustainable CPD, to create the conditions for further sustainable changes in science education. Indeed, the very notion of CPD for teachers of science may need to be promoted in some countries. Acting as catalysts, EU-funded initiatives can stimulate the national political decision-makers to create the conditions for further changes in science education and the relevant education establishments, so that they may implement inquiry-based CPD in a sustainable (not project-based) way.

TWO CONCLUDING REMARKS

A systemic renewal of science education is still a long way off:

It is not easy to describe in a few lines the present systemic impact of the many past IBSE-related pilot projects on the rejuvenation of science education in Europe. At present, programmes have been launched at national levels whose results will probably be accepted by communities, employers and employees, teachers and parents as the basis for some restructuring in a strategic process of change. This may lead to gradual changes in outlook as regards public acceptance, which in turn paves the way for acceptance of the necessary administrative or legislative measures. Clearly, interventions by the these groups can help convince high-level political decision makers. In this area of promoting a gradual shift in political and social discourse, the academies also have their role to play.

Under the principle of subsidiarity European initiatives can trigger reflections and debates notably as result of a subtle peer learning process. Hence future actions at the European level should keep in mind the necessary linkage between Europe-wide exchange and structural impact at the local, regional and national level.

Expanding the efforts to renew science education beyond Europe:

The last, but by no means least, of the recommendations concerns a worldwide and global aspect: science is universal and all scientists are connected in worldwide networks. These existing networks can be used to broaden the European activities and, at a very low additional cost, make past European investment in science education bear fruit elsewhere too. The numerous and excellent training resources that were created in the past thanks to the European co-funded IBSE projects could easily be translated and shared with the countries of neighbouring areas, including the neighbouring Muslim countries, for which the 'Arab spring' heralds new challenges and opportunities; there are also openings in the emerging economies of Central Asia, which are keen to develop their educational system. As regards Africa, there could be an opportunity to establish science education as a long-term topic in dialogue and strategy meetings between the European Union and African Union, starting for example during the next 2012 autumn EU/AU summit. Academies, through their European ALLEA and global IAP networks, are fully ready to support this potentially important aspect of Europe's global engagement for peace, sustainable prosperity, human security and human rights.

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ALL European Academies (ALLEA)

ALLEA, the federation of All European Academies, was founded in 1994 and currently brings together 52 Academies in more than 40 countries from the Council of Europe region. Member Academies operate as learned societies, think tanks and research performing organisations. They are self-governing communities of leaders of scholarly enquiry across all fields of the natural sciences, the social sciences and the humanities. ALLEA therefore provides access to an unparalleled human resource of intellectual excellence, experience and expertise.
Independent from political, commercial and ideological interests, ALLEA's policy work seeks to contribute to improving the framework conditions under which science and scholarship can excel. Jointly with its Member Academies, ALLEA is in a position to address the full range of structural and policy issues facing Europe in science, research and innovation. In doing so, it is guided by a common understanding of Europe bound together by historical, social and political factors as well as for scientific and economic reasons.

Member Academies

Albania: Akademia E Shkencave E Shqipërisë; **Austria**: Österreichische Akademie der Wissenschaften; **Belarus**: Нацыянальная акадэмія навук Беларусі; **Belgium**: Académie Royale des Sciences des Lettres et des Beaux-Arts de Belgique; Koninklijke Vlaamse Academie van België voor Wetenschappen en Kunsten; **Bosnia and Herzegovina**: Akademija nauka i umjetnosti Bosne i Hercegovine; **Bulgaria**: Българска академия на науките; **Croatia**: Hrvatska Akademija Znanosti i Umjetnosti; **Czech Republic**: Akademie věd České republiky; **Denmark**: Kongelige Danske Videnskabernes Selskab; **Estonia**: Eesti Teaduste Akadeemia; **Finland**: Suomen Tiedeakatemiain Valtuuskuntal; **France**: Académie des Sciences - Institut de France; Académie des Inscriptions et Belles-Lettres; Académie des Sciences Morales et Politiques; **Georgia**: საქართველოს მეცნიერებათა ეროვნული აკადემია; **Germany**: Deutsche Akademie der Naturforscher Leopoldina; Union der deutschen Akademien der Wissenschaften; Akademie der Wissenschaften in Göttingen, Akademie der Wissenschaften und der Literatur Mainz, Bayerische Akademie der Wissenschaften, Berlin-Brandenburgische Akademie der Wissenschaften, Akademie der Wissenschaften zu Hamburg, Heidelberger Akademie der Wissenschaften, Nordrhein-Westfälische Akademie der Wissenschaften und der Künste, Sächsische Akademie der Wissenschaften zu Leipzig (Associated Academies); **Greece**: Ακαδημία Αθηνών; **Hungary**: Magyar Tudományos Akadémia; **Iceland**: Vísindafélag Islendinga; **Ireland**: The Royal Irish Academy - Acadamh Ríoga na hÉireann; **Israel**: למדעים הישראלית הלאומית האקדמיה; **Italy**: Accademia Nazionale dei Lincei; **Kosovo**: Akademia e Shkencave dhe e Arteve e Kosovës; **Latvia**: Latvijas Zinātņu akadēmija; **Lithuania**: Lietuvos mokslų akademijos; **Macedonia**: Македонска Академија на Науките и Уметностите; **Moldova**: Academia de Ştiinţe a Moldovei; **Montenegro**: Crnogorska akademija nauka i umjetnosti; Netherlands: Koninklijke Nederlandse Akademie van Wetenschappen; **Norway**: Det Norske Videnskaps-Akademi; **Poland**: Polska Akademia Umiejętności ; Polska Akademia Nauk; **Portugal**: Academia das Ciências de Lisboa; **Romania**: Academia Română; **Russia**: Российская академия наук; **Serbia**: Srpska Akademija Nauka i Umetnosti; **Slovakia**: Slovenská Akadémia Vied; **Slovenia**: Slovenske akademije znanosti in umetnosti; **Spain**: Real Academia de Ciencias Morales y Políticas; Real Academia de Ciencias Exactas, Físicas y Naturales; **Sweden**: Kungl. Skogs- och Lantbruksakademien; Kungl. Vetenskapsakademien; Kungl. Vitterhets Historie och Antikvitets Akademien; **Switzerland**: Akademien der Wissenschaften Schweiz; **Turkey**: Türkiye Bilimler Akademisi; **Ukraine**: Національна академія наук України; **United Kingdom**: The British Academy; The Royal Society of Edinburgh; The Royal Society of London; **Vatican**: Pontificia Academia Scientiarum

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